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# SPRING OATS



## VARIETIES FOR ILLINOIS

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and  
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# Spring Oat Varieties for Illinois

By GEORGE H. DUNGAN, O. T. BONNETT, and W. L. BURLISON<sup>1</sup>

## CHANGES IN ACREAGE AND YIELDS

**O**F THE FARM CROPS grown in Illinois oats rank second in acreage, being exceeded only by corn. The peak in oat acreage was reached in 1925, when 4,724,000 acres were devoted to this crop. Since that time the amount of Illinois farm land in oats has declined until in 1940 only 3,177,000 acres were used for oat production. In only two years since 1899, namely 1934 and 1939, has the

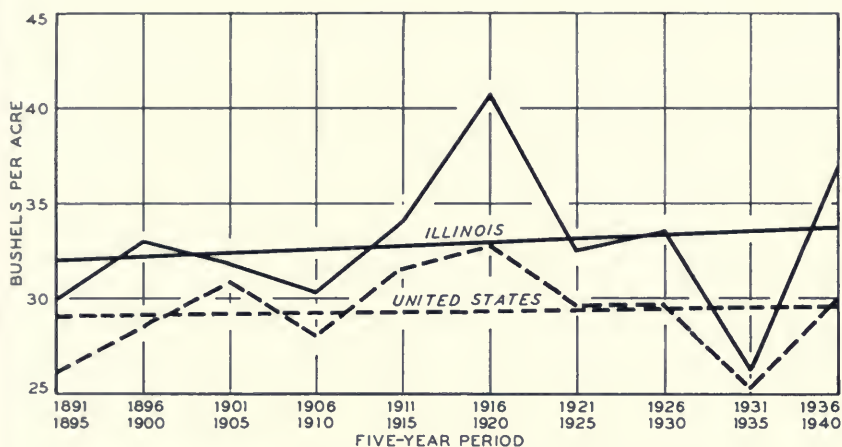


Fig. 1.—Illinois and U. S. oat yields. The trend during these 50 years shows a greater gain in acre-yields in Illinois (1.8 bushels) than in the United States ( $\frac{1}{2}$  bushel).

oat acreage fallen below the 1940 figure. The acreage in 1941 was about 250,000 higher than in 1940.

Average acre-yields of oats for the state have varied widely during the last forty years. The highest state average ever attained was reached in 1917, when 52 bushels an acre were produced. It happened that the acreage that year was close to the top, with the result that Illinois recorded a phenomenal crop of 244,400,000 bushels. This was almost 95 million bushels more than the 1940 oat crop, the second all-time high, which gave an average yield of 48 bushels an acre.

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At the other extreme were the low acre-yields of 1933 and 1934, the only years showing yields of less than 20 bushels an acre as far back as records go. The 1933 yield was 19.5 bushels and the 1934 yield only 11 bushels. With plantings of only a little over 3 million acres in 1934, the total production came to less than 33½ million bushels.

Thus between the largest oat crop in 1917 and the smallest one in 1934 was a difference of 41 bushels in acre-yield and 211 million bushels in total yield.

For the United States as a whole the average acre-yield of oats has been slightly upward over the last fifty years, having increased from an average of 26.2 bushels for the five-year period 1891-1895 to 29.9 bushels for 1936-1940 (Fig. 1). For Illinois the yields for the corresponding five-year periods were 30 bushels and 36.7 bushels respectively.

### BETTER VARIETIES A REASON FOR BETTER YIELDS

Seasonal conditions and varietal adaptation each play a very important part in determining acre-yields of farm crops. Growing early-maturing varieties that are consistently good yielders has tended to stabilize the acre production of oats at a high level over a period of

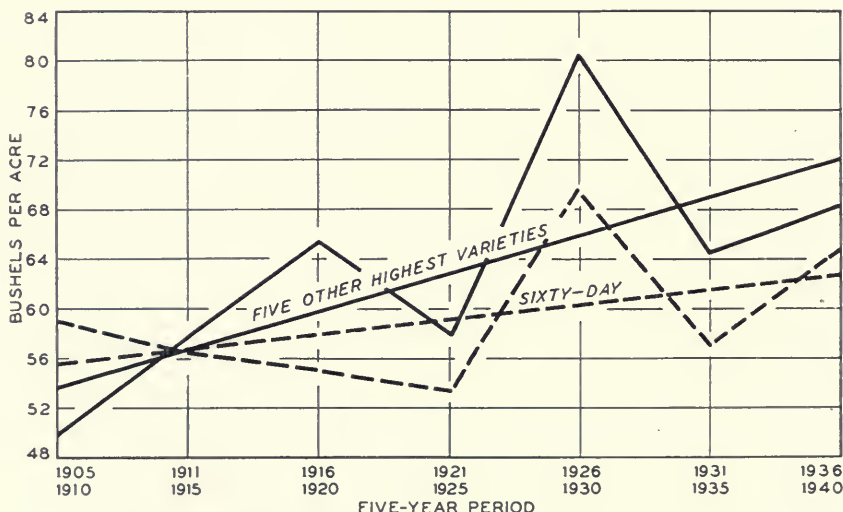


Fig. 2.—Oat yields at Urbana. Sixty-Day oats increased an average of 6.8 bushels an acre during this 36-year period (1905-1940), as shown by the straight trend line, whereas the five other highest yielding varieties increased 18 bushels, demonstrating what can be done in improving yields by selection and breeding. The varieties in the highest yielding group changed, of course, many times during this period as improvements were made. (Data for 1906 are omitted because of irregularities in planting.)

years. In years especially favorable for late oats early varieties fall short of the long-season types in yield, but they more than make up their losses in seasons unfavorable for the late varieties.

The effect that breeding and variety trials have had in increasing oat yields can be seen by comparing the records of Sixty-Day and other high-yielding varieties over the last forty-five years.

In the Southwest rotation, consisting of corn, oats, red clover, and wheat, the variety Sixty-Day has been included during the entire period. During the first five years Sixty-Day was tested it yielded an average of 9 bushels an acre more than the average of the five other best varieties (Fig. 2). During the next five years new early varieties were developed and some of them were included in the tests. Improvement was so marked that at the end of the second five-year period the average yield of the five highest varieties other than Sixty-Day was a little more than that of Sixty-Day. At the end of the forty-five-year period the five highest yielding varieties exceeded Sixty-Day by 3.6 bushels an acre. This means that, using the yield of Sixty-Day as a criterion, the five best varieties other than Sixty-Day increased in yield 12.6 bushels during the forty-five years.

### SOIL TREATMENT ON TEST FIELDS

*DeKalb.*—The soil on the DeKalb field in northern Illinois consists of a number of types all common to the region. The rotation has been corn, corn, oats, and alsike clover, with soybeans substituting in years when clover failed. For the past ten years the entire crop of alsike clover and soybeans in this rotation has been plowed down for soil enrichment. An application of rock phosphate has been made when soil tests showed a need for phosphorus.

*Mt. Morris.*—In 1941 oat variety tests in northern Illinois were made immediately east of the soil experiment field at Mt. Morris. The soil type is variable, consisting of different phases of Tama and Muscatine silt loams, and the land had received no fertilizer except light and irregular applications of manure. As closely as circumstances permitted, the rotation followed was corn, small grain, and clover-timothy mixed.

*Urbana.*—Oat variety tests at Urbana in central Illinois have been conducted on Muscatine silt loam soil in a rotation of corn, oats, red clover or soybeans, and wheat. In the early years of the tests the west side of half the plots received residues and rock phosphate; the east side received residues, rock phosphate, and limestone. The west side of the other half of the plots received manure and rock phosphate; the east side received manure, rock phosphate, and limestone. Beginning in 1934 the residues have been omitted and manure substituted,

so that all plots now receive essentially the same treatment except that ground limestone is applied to the east half of the plots while the west half receives no limestone.



Fig. 3.—Fields where varieties were tested. Until 1941 the northern tests were made at DeKalb; the 1941 oat crop was grown at Mt. Morris instead of DeKalb.

*Alhambra.*—The soil on the Alhambra field in southern Illinois is Putnam silt loam with numerous “slick” spots. Oats are grown in a rotation of corn, oats with sweet clover, soybeans, and wheat with sweet clover. All plots have been fertilized with crop residues, ground limestone, and rock phosphate.

### METHODS OF CONDUCTING THE TESTS

Prior to 1940 the yield tests of spring oats at DeKalb and Alhambra consisted of either duplicate  $\frac{1}{10}$ - or  $\frac{1}{5}$ -acre plots. At Urbana the plots have been  $\frac{1}{70}$  acre in size and eight such plots were used for each variety.

In 1940 and in 1941 six plots, either  $\frac{1}{35}$  or  $\frac{1}{70}$  acre in size, were

used for each variety on all three of the above fields. When Mt. Morris was substituted for DeKalb in 1941 only five plots of each variety were grown. The arrangement of entries within each of the test fields was strictly random.

The grain was seeded with an 8-inch disk drill. The rate of seeding, except where a study of seeding rate was being made, was 8 pecks an acre or as near to this as practicable.

The plots were harvested with a grain binder and threshed with a standard 22-inch separator. Yield determinations on grain and straw were based upon weights obtained at threshing time.

Grain yields of each variety have been compared with the average yield of all varieties grown in the same years, and the different varieties have been rated according to the amount by which they have exceeded or have fallen below this average.

## HIGHEST GRAIN-YIELDING VARIETIES

The records made by different varieties in the production of grain are shown in Tables 1, 2, and 3. Only those varieties which have been in the tests during the past twelve years have been included. For varieties that have been in the tests for more than twelve years, all previous yields have been included in calculating ratings but the earlier annual yields are not shown in the tables.<sup>1</sup>

### Northern Illinois

On the DeKalb field in northern Illinois the ten highest yielding varieties tested for three or more years during 1929-1941 are listed below in the order of their rank compared with the average:

<i>Bushels per acre above average</i>		<i>Bushels per acre above average</i>	
Marion (C.I. 3247).....	10.5	Fort.....	3.1
Iowar.....	6.1	Columbia.....	2.5
Albion.....	4.5	Kanota.....	2.5
Richland.....	3.6	Illinois 30-2088.....	2.1
Gopher.....	3.3	Wayne.....	2.1

Marion, a variety developed cooperatively by the U. S. Department of Agriculture and the Iowa Experiment Station, is resistant to stem rust and smut and moderately resistant to crown or leaf rust. It is a white oat with a high test weight and a moderately stiff straw. It matures about three days later than Sixty-Day.

Iowar is a selection from Kherson made by the Iowa Station. It is slightly later in maturing than Sixty-Day and has a straw somewhat taller and stiffer.

<sup>1</sup>For test yields immediately prior to 1929, see Ill. Agr. Exp. Sta. Bul. 339, pp. 21-50, 1929.





TABLE 1.—YIELDS OF SPRING OATS ON DEKALB AND MT. MORRIS FIELDS—*Concluded*  
(Bushels per acre)

Rank	Variety	Bushels above (+) or below (—) average of all varieties <sup>a</sup>		Num- ber of years grown	Varieties grown one or two years only												
		Aver- age yield			1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941
	Victoria X Richland (C.I. 3602)	+17.3	64.8	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64.8
	Victoria X Richland (C.I. 3337)	+14.6	62.1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62.1
	Iowa D77	+12.9	54.9	1	.....	.....	54.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	59.6
	Tama (C.I. 3502)	+12.1	59.6	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Mark-Rain, X Vict.-Rich. (C.I. 3607)	+9.0	56.5	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	56.5
	Boone (C.I. 3305)	+8.8	82.5	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	104.2	60.7
	Victoria X Richland (C.I. 3336)	+5.8	53.3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	53.3
	Vicland (C.I. 3611)	+4.1	77.9	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	99.4	58.7
	Vanguard	+4.1	77.9	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	110.8	45.0
	Markton X Rainbow (C.I. 3341)	-1.0	72.3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61.2	97.0	.....
	Markton (C.I. 3346)	-1.5	72.3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	93.8	50.7
	Hancock (C.I. 3346)	-1.5	72.3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	107.1	37.4
	Swedish Star	-1.8	55.3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Markton X Iogold (C.I. 3240)	-2.2	45.3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Erban	-2.2	45.3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Iowa D69	-3.2	38.8	1	.....	.....	38.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Victor	-6.6	58.3	2	.....	98.6	18.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Brunker	-7.2	72.9	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Carlier	-7.4	40.1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Legacy	-12.1	35.4	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Markton	-22.0	47.0	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	Eagle	-26.7	20.8	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20.8
	Average yield of all varieties	.....	.....	..	69.0	87.8	42.0	73.3	54.2	13.1	55.5	64.5	45.6	54.8	60.2	100.1	47.5

<sup>a</sup>Grown the same years. <sup>b</sup>Yields of hull-less oats were calculated on the basis of 22.4 pounds to the bushel.







Albion, another selection made from Kherson by the Iowa Station, is fully as early as Sixty-Day, which variety it resembles closely except that it yields higher.

Richland was also selected from Kherson by the Iowa Station. It is an early oat having a creamy white grain and a straw distinctly more lodge-resistant than that of Sixty-Day. It is resistant to stem rust.

Gopher, a selection from Sixty-Day made by the Minnesota Station, is a white oat with a comparatively stiff straw. It is slightly later than Sixty-Day.

Fort is a selection from Sixty-Day made by the Illinois Station. It resembles that variety in many respects and is not believed to be distinctly superior even in yielding ability.

Columbia, a tannish-gray oat developed as a selection from Fulghum by the Missouri Station, has a medium-stiff straw, matures early, and produces grain with high test weight.

Kanota is a strain of Fulghum isolated by the Kansas Station. Its grain has a bronze color. It matures early and is capable of enduring unfavorable conditions associated with seeding earlier than normal.

Illinois 30-2088, a selection from a cross of Sixty-Day with a Fulghum selection (Kansas 5396) was developed at the Illinois Station. It resembles Columbia very closely in appearance, stiffness of straw, time of maturity, and yielding ability in northern Illinois.

Wayne is a selection from a hybrid made by the Ohio Station. It is a white oat which matures considerably later than Sixty-Day altho somewhat earlier than Silvermine.

New strains selected out of Victoria  $\times$  Richland show unusual promise on the northern field on the basis of one and two years' tests. In 1941 the seven selections tested produced an average yield of 59.4 bushels an acre, or 13 bushels more than Gopher, the highest yielding old variety not resistant to rust.

### Central Illinois

In central Illinois on the Urbana field the seven varieties leading in yielding ability in tests made for three or more years during 1929-1941 are the following:

<i>Bushels per acre above average</i>		<i>Bushels per acre above average</i>	
Marion (C.I. 3247).....	9.5	Gopher.....	4.0
Columbia.....	5.4	Markton $\times$ Rainbow (C.I.	
Boone (C.I. 3305).....	5.2	3341).....	3.9
Kanota.....	4.7	Burt (C.I. 293).....	3.9

Marion showed its superiority in central Illinois over varieties susceptible to rust in 1938 and also in 1941. In years when rust is not a factor in determining yield, Marion will probably not be any better than Columbia, which has a wide range of adaptation.

Boone is a selection from a cross between Victoria and Richland made by the U. S. Department of Agriculture in cooperation with the Iowa Station. It is resistant to crown rust, black stem rust, and smut. It has a short fairly stiff straw and produces grain that is of good quality but has a slightly lower percentage of groats, or hull-free kernels, than Marion.

Kanota, altho a high-yielding variety, will perhaps never replace Columbia, which is not so seriously handicapped by late seeding.

Gopher yielded exceptionally well in 1940 when it gave 6 bushels above the average.

Markton  $\times$  Rainbow (C.I. 3341) is very similar to its sister strain, Marion, both in appearance and in disease resistance but it probably will never be distributed as a commercial variety in central Illinois because it is somewhat lower yielding there than Marion.

Burt (C.I. 293) is a strain of the Burt oat having a reddish-brown grain. It is very early, being especially suitable for late seeding.

As on the northern experiment field the new selections out of Victoria  $\times$  Richland have shown themselves to be extraordinarily well suited during one or two years' tests.

### Southern Illinois

In southern Illinois on the Alhambra field, the nine highest yielding varieties tested three or more years during 1929-1941 are shown below with the amount each has exceeded the average:

<i>Bushels per acre above average</i>		<i>Bushels per acre above average</i>	
Brunker.....	6.6	Marion (C.I. 3247).....	2.7
Columbia.....	3.3	Iowar.....	2.5
Burt (C.I. 293).....	3.1	Albion.....	2.3
Markton $\times$ Rainbow (C.I. 3341).....	3.1	Illinois 30-2088.....	2.3
		Markton $\times$ Rainbow (C.I. 3342).....	2.3

Because of the capacity of Brunker to yield well in dry seasons it has a good record at Alhambra. However, it is not recommended for growing in Illinois on account of its extreme susceptibility to lodging.

Considering yield, quality, and resistance to lodging, Columbia is the best all-round oat variety for southern Illinois and will continue to be until some of the new varieties demonstrate their superiority to it.

Burt (C.I. 293) is hardy and matures early enough to escape the heat of midsummer. For this reason it is a consistent producer in this area.

Markton  $\times$  Rainbow (C.I. 3341) and Marion are similar in plant and kernel characteristics. Even tho C.I. 3341 has a yield record at Alhambra slightly higher than that of Marion, the difference is not believed to be significant.

In the main, varieties of oats with colored grain do best in the

TABLE 3.—SOUTHERN ILLINOIS, ALHAMBRA FIELD: GRAIN YIELDS OF VARIETIES OF SPRING OATS, 1929-1941  
(Bushels per acre)

Rank	Variety	Above (+) or below (-) average of all varieties <sup>a</sup>	Num- ber of years grown	Varieties grown three or more years													
				1929	1930	1931	1932	1933	1934	1935	1936 <sup>b</sup>	1937	1938	1939	1940	1941	
1	Brunker.....	+6.6	41.1	9	....	....	63.7	66.3	24.3	38.8	19.4	....	20.8	26.9	42.6	67.0	....
2	Columbia.....	+3.3	38.1	10	....	....	61.0	69.9	15.9	34.0	18.1	....	15.7	22.3	39.2	65.7	39.4
3	Burt (C.I. 293).....	+3.1	35.9	8	....	62.1	49.0	68.1	16.1	36.2	22.0	....	7.0	27.4	....	....	....
4	Markton X Rainbow (C.I. 3341).....	+3.1	50.5	3	....	....	....	....	....	....	....	....	....	....	41.9	70.3	39.5
5	Marion (C.I. 3247).....	+2.7	50.1	3	....	....	....	....	....	....	....	....	....	....	45.5	66.3	38.5
6	Iowa.....	+2.5	37.7	8	5.7	62.2	....	....	....	....	....	....	....	....	....	....	....
7	Albion.....	+2.3	31.6	12	6.7	59.0	....	....	....	....	....	....	....	....	....	....	....
8	Illinois 30-2088.....	+2.3	38.7	5	....	....	....	....	....	....	....	....	....	....	....	....	....
9	Markton X Rainbow (C.I. 3342).....	+2.3	49.7	3	....	....	....	....	....	....	....	....	....	....	....	....	....
10	Burt.....	+1.8	37.0	8	5.7	52.9	....	....	....	....	....	....	....	....	42.5	69.2	39.4
11	Gopher.....	+1.7	47.6	8	6.5	57.7	48.7	62.8	....	....	....	....	....	....	44.0	66.2	38.9
12	Big Four.....	+1.7	30.0	12	2.7	55.2	52.0	....	....	....	....	....	....	....	....	....	....
13	Iogold.....	+6	41.1	4	8.8	55.5	....	....	....	....	....	....	....	....	....	....	....
14	Silvermine.....	+3	30.8	13	2.9	57.8	24.5	....	....	....	....	....	....	....	....	....	....
15	Illinois 137.....	+2	27.1	6	....	....	....	....	....	....	....	....	....	....	....	....	....
16	Fort.....	0	33.8	9	....	....	....	....	....	....	....	....	....	....	....	....	....
17	Sixty-Day.....	-1	32.2	22	5.5	54.8	48.1	59.1	14.9	28.6	16.2	....	16.4	26.5	40.9	60.9	38.2
18	Kanota.....	-1.1	26.8	7	....	....	56.1	....	....	....	....	....	14.1	28.2	39.7	59.6	37.7
19	Burt (Nebr. 517).....	-1.7	45.7	3	....	....	....	....	....	....	....	....	....	....	36.3	63.2	37.6
20	Franklin.....	-3.6	14.5	4	....	....	....	....	10.4	29.6	13.2	....	....	....	....	....	....
21	Minota.....	-4.1	36.4	4	3.1	51.3	30.5	....	....	....	....	....	....	....	....	....	....
22	Nova.....	-5.6	34.9	4	4.2	54.4	24.7	....	....	....	....	....	....	....	....	....	....
23	Fowl Hull-less.....	-12.2 <sup>c</sup>	21.0	5	....	....	25.2	54.4	4.3	12.5	8.6	....	....	....	....	....	....
Varieties grown one or two years only																	
	Markton X Iogold (C.I. 3239).....	+1.6	42.5	1	....	....	....	....	....	....	....	....	....	....	42.5	....	....
	Markton X Iogold (C.I. 3240).....	+1.0	41.9	1	....	....	....	....	....	....	....	....	....	....	41.9	....	....
	Victoria X Richland (C.I. 3337).....	+1	37.5	1	....	....	....	....	....	....	....	....	....	....	....	....	37.5
	Victoria X Richland (C.I. 3336).....	+4	37.0	1	....	....	....	....	....	....	....	....	....	....	....	....	37.0
	Boone (C.I. 3305).....	-1.5	49.1	2	....	....	....	....	....	....	....	....	....	....	....	61.8	36.3
	Markton X Rainbow (C.I. 3241).....	-4.3	36.6	1	....	....	....	....	....	....	....	....	....	....	36.6	....	....
	Markton X Iogold (C.I. 3237).....	-5.2	45.4	2	....	....	....	....	....	....	....	....	....	....	....	58.3	32.4
	Hancock (C.I. 3346).....	-6.5	44.1	2	....	....	....	....	....	....	....	....	....	....	....	54.5	33.7
	Average yield of all varieties.....	....	....	..	5.2	56.6	44.0	62.9	13.4	29.0	16.7	....	13.1	26.5	40.9	63.8	37.4

<sup>a</sup>Grown the same years. <sup>b</sup>No oats were grown in 1936; the plots were flooded in the late spring. <sup>c</sup>Calculated as 22.4 pounds to the bushel.

southern part of the state. Iowar and Albion, which are white oats, owe their favorable yield record in southern Illinois to their earliness.

## HIGHEST STRAW-YIELDING VARIETIES

Frequently the straw produced by oats is as valuable as the grain. Most of the varieties that are the highest producers of grain are below average in yield of straw (Table 4). Of the ten best-yielding grain varieties in northern Illinois, eight were below average in amount of straw produced and only two varieties, Marion and Wayne, exceeded the average in straw yield.

At Urbana only two of the seven leading grain varieties were above average in straw yields; these were Marion and Markton  $\times$  Rainbow (C.I. 3341).

At Alhambra as many as seven of the nine varieties yielding the most grain also produced more straw than average. They were Brunker, Columbia, Markton  $\times$  Rainbow (C.I. 3341), Marion, Iowar, and Illinois 30-2088. More of the high-yielding grain varieties at Alhambra produced higher-than-average yields of straw because the straw yields are low on this field. Practically all the varieties grown here are early varieties, and these yield less straw than the midseason and late varieties.

## GROATS YIELD OF SEVERAL VARIETIES

Altho weight per bushel is a fairly good basis for judging quality in oats, it is considered less dependable than the percentage of meat, or groats, which is perhaps the best measure of quality. Seemingly the

TABLE 5.—PERCENTAGE OF GROATS AND WEIGHT PER BUSHEL FOR THIRTEEN OAT VARIETIES GROWN AT URBANA DURING 1939-1941

Variety	Percentage of groats <sup>a</sup>				Weight per bushel			
	1939	1940	1941	Average	1939	1940	1941	Average
					lb.	lb.	lb.	lb.
Boone (C.I. 3305).....	73.1	70.5	78.2	73.9	31.5	35.6	31.6	32.9
Columbia.....	74.2	74.5	74.3	74.3	31.0	36.7	30.0	32.6
Fort.....	75.7	76.5	71.9	74.7	29.5	31.1	26.3	29.0
Gopher.....	75.1	73.6	63.5	70.7	28.5	34.2	24.7	29.1
Hancock (C.I. 3346).....	74.8	76.0	78.0	76.3	30.5	36.3	31.3	32.7
Illinois 30-2088.....	74.9	75.9	75.3	75.4	32.8	35.3	30.4	32.8
Marion (C.I. 3247).....	74.7	76.4	73.5	74.9	32.0	35.5	30.6	32.7
Markton $\times$ Rainbow (C.I. 3341).....	75.8	74.7	71.6	74.0	31.0	35.5	28.7	31.7
Markton $\times$ Rainbow (C.I. 3342).....	74.0	74.0	70.8	73.9	31.3	35.2	28.0	31.5
Rustless.....	75.5	72.3	71.1	73.0	27.8	31.0	25.2	28.0
Sixty-Day.....	77.6	74.9	66.9	73.1	28.3	33.0	25.7	29.0
Swedish Star.....	67.3	71.5	64.8	67.9	26.3	34.3	22.5	27.7
Vanguard.....	74.5	72.6	65.0	70.7	29.0	32.1	24.9	28.7
Average.....	74.4	74.1	71.1	73.3	30.0	34.3	27.7	30.6

<sup>a</sup>Percentage of hull can be determined by subtracting the percentage of groats from 100.



TABLE 4.—STRAW YIELDS OF VARIETIES OF SPRING OATS GROWN AT DEKALB, URBANA, AND ALHAMBRA DURING 1929-1941  
(Tons per acre)

Variety	DeKalb			Urbana			Alhambra		
	Average yield	Above (+) or below (—) average varieties*	Number of years grown	Average yield	Above (+) or below (—) average varieties*	Number of years grown	Average yield	Above (+) or below (—) average varieties*	Number of years grown
Albion.....	1.03	— .29	2	1.13	— .24	2	.58	— .07	2
Anthony.....	2.09	+ .60	3	2.01	+ .36	4			
Big Four.....	1.79	+ .39	1	1.70	+ .33	2	.77	— .12	2
Boone (C.I. 3305).....	1.18	— .03	1	1.10	— .08	3	.64	— .06	2
Brunker.....	.98	— .23	2	1.04	— .20	9		+ .06	9
Burt.....				1.24	— .13	2	.59	— .06	2
Burt (C.I. 293).....	1.07	— .16	6	1.17	— .10	8	.79	— .03	8
Burt (Nebr. 517).....		+ .12	1	1.06	— .02	8	.82	+ .02	3
Cartier.....	1.07	+ .12	10	1.27	+ .10	1			
Columbia.....	1.08	— .07	10	1.13	+ .12	10	.84	+ .02	10
Cornellian.....				1.69	+ .33	2			
Eagle.....	.74	— .21	1	1.30	+ .13	1			
Erban.....	1.08	+ .13	1	1.15	— .02	1			
Fort.....	.99	— .20	5	1.00	— .23	11	.72	— .06	9
Fowld Hull-less.....	1.23	+ .10	8	1.27	+ .02	11	.95	+ .05	5
Franklin.....	1.18	+ .10	4	1.21	+ .18	5	.92	+ .12	4
Golden Silvermine.....	1.42	+ .20	7	1.19	+ .17	6			
Gopher.....	1.22	— .07	9	1.15	+ .12	12	.88	+ .21	7
Great Avalanche.....		+ .10	2	2.11	+ .46	4	.75	+ .05	2
Hancock (C.I. 3346).....	1.31			1.22	+ .03	3			
Illinois 105.....				.99	— .07	6			
Illinois 137.....	.94	— .21	7	1.03	— .22	8	.73	— .05	6
Illinois 30-2088.....	1.17	— .02	5	1.09	— .06	5	.86	+ .12	5
Illinois Hull-less.....				1.45	— .07	5			
Iogold.....	1.13	— .36	3	1.38	— .41	3	.80	0	3
Iogren.....	1.56	+ .07	3	1.53	+ .16	2			
Iowa D4.....				2.25	— .38	1			
Iowa D67.....				2.04	— .59	1			
Iowa D69.....	1.18		1	3.51	+ .88	1			
Iowa D77.....	1.47	— .36	1	2.76	+ .13	1			
Iowa D102.....				3.10	+ .47	1			
Iowar.....	1.25	— .06	6	1.42	— .21	4	.66	+ .01	2
Kanota.....	1.22	— .27	3	1.45	— .34	3	1.10	— .01	1
Keystone.....	1.43	+ .25	3	1.23	+ .20	6			
Legacy.....	.85	— .10	1	1.21	+ .03	1			
Marion (C.I. 3247).....	1.24	+ .07	4	1.18	+ .04	4	.87	+ .07	3

\*Grown the same years.

TABLE 4.—STRAW YIELDS OF SPRING OATS GROWN AT DeKALB, URBANA, AND ALHAMBRA—Concluded  
(Tons per acre)

Variety	DeKalb			Urbana			Alhambra		
	Average yield	Above (+) or below (—) average of all varieties*	Number of years grown	Average yield	Above (+) or below (—) average of all varieties*	Number of years grown	Average yield	Above (+) or below (—) average of all varieties*	Number of years grown
Markton. X logold (C.I. 3237).....	1.46	+ .06	1	1.84	+ .19	4	1.65	— .05	2
Markton X logold (C.I. 3239).....	1.27	+ .02	3	1.07	— .07	4	1.07	— .34	1
Markton X logold (C.I. 3240).....	1.04	— .08	2	1.02	+ .03	1	1.02	— .03	1
Markton X logold (C.I. 3392).....	1.04	.....	.....	1.08	+ .02	1	1.08	.....	.....
Markton X logold 2737 (Sel. 200-5).....	1.04	.....	.....	1.01	+ .02	1	1.01	.....	.....
Markton X Rainbow (C.I. 3241).....	1.24	+ .03	2	1.20	+ .14	1	1.25	+ .25	1
Markton X Rainbow (C.I. 3341).....	1.22	— .02	3	1.19	+ .05	4	1.22	+ .16	3
Markton X Rainbow (C.I. 3342).....	1.22	+ .07	1	1.21	+ .07	4	1.21	+ .18	3
Mark.-Rain. X Vict.-Rich. (C.I. 3607).....	1.02	.....	.....	1.11	— .06	1	1.11	.....	.....
Miami.....	1.77	+ .28	3	1.50	+ .13	2	1.50	.....	.....
Minota.....	1.77	.....	.....	2.08	+ .63	3	1.77	— .03	3
Naesgaard.....	2.06	+ .57	3	1.77	+ .23	1	2.08	.....	.....
Nebraska 21.....	1.42	+ .24	3	1.31	— .21	1	1.31	.....	.....
Nova.....	1.42	— .33	2	2.22	+ .77	3	2.22	— .01	3
Patterson.....	.99	.....	.....	1.17	+ .14	6	1.17	.....	.....
Richland.....	1.20	+ .01	6	1.06	— .31	2	1.06	.....	.....
Royal Scott.....	1.20	.....	.....	1.62	+ .37	2	1.62	.....	.....
Rustless.....	1.67	+ .20	3	1.22	+ .07	5	1.22	.....	.....
Silver.....	1.02	— .21	13	1.70	+ .16	1	1.70	.....	.....
Sixty-Day.....	1.29	— .20	3	2.23	+ .48	3	2.23	— .04	3
Sixty-Day (Selection).....	1.53	.....	.....	1.09	— .18	12	1.09	— .09	12
State Pride.....	.87	— .08	1	.90	— .64	1	.90	.....	.....
Swedish Star.....	1.47	+ .26	2	1.51	— .28	3	1.51	.....	.....
Tama (C.I. 3502).....	2.33	+ .79	2	1.46	+ .28	3	1.46	.....	.....
Texas Red.....	1.04	— .17	2	1.20	+ .02	1	1.20	.....	.....
Vanguard.....	1.47	.....	.....	1.33	— .04	2	1.33	.....	.....
Vicland (C.I. 3611).....	2.33	.....	.....	1.38	+ .20	3	1.38	.....	.....
Victor.....	.83	— .12	1	1.14	— .11	2	1.14	.....	.....
Victoria X Richland (C.I. 3310).....	.92	— .03	1	1.09	— .09	1	1.09	.....	.....
Victoria X Richland (C.I. 3336).....	.93	— .02	1	1.04	— .14	1	1.04	— .11	1
Victoria X Richland (C.I. 3337).....	1.29	+ .19	5	1.09	— .08	1	1.09	— .08	1
Victoria X Richland (C.I. 3602).....	.....	.....	.....	.90	— .27	1	.90	.....	.....
Victory.....	.....	.....	.....	3.89	+ .26	1	3.89	.....	.....
Wayne.....	.....	.....	.....	1.50	+ .22	7	1.50	.....	.....

\*Grown the same years.

hull tends to lie closer to the kernel in some varieties than in others. When the kernel fits tightly in the hull and there is no air space between, the oats will weigh high and yet they may not possess high feeding value. For purposes of comparison both the average percentage of

TABLE 6.—PERCENTAGE OF GROATS IN SEVEN VARIETIES OF OATS WHEN GROWN IN NORTHERN, CENTRAL, AND SOUTHERN ILLINOIS DURING 1939-1941

(Varieties arranged in order of highest average groats percentage for the year)

Variety	Northern Illinois (DeKalb)	Central Illinois (Urbana)	Southern Illinois (Alhambra)	Average
1939				
Illinois 30-2088.....	75.4	74.9	70.8	73.7
Sixty-Day.....	74.9	77.6	68.4	73.6
Columbia.....	76.4	74.2	69.9	73.5
Fort.....	75.7	75.7	68.4	73.3
Marion (C.I. 3247).....	73.9	74.7	71.2	73.3
Gopher.....	72.2	75.1	67.1	71.5
Markton X Rainbow (C.I. 3342).....	70.8	74.0	67.1	70.6
Average.....	74.2	75.2	68.8	72.8
1940				
Marion (C.I. 3247).....	77.0	76.4	73.9	75.8
Sixty-Day.....	78.8	74.9	73.0	75.6
Fort.....	77.6	76.5	72.6	75.6
Illinois 30-2088.....	75.8	75.9	73.4	75.0
Columbia.....	76.3	74.5	74.0	74.9
Gopher.....	76.2	73.6	72.4	74.1
Markton X Rainbow (C.I. 3342).....	75.4	74.0	71.4	73.6
Average.....	76.7	75.1	73.0	74.9
1941*				
Marion (C.I. 3247).....	75.5	73.5	73.6	74.2
Illinois 30-2088.....	69.7	75.3	74.4	73.1
Columbia.....	71.5	74.3	72.6	72.8
Fort.....	73.5	71.9	72.1	72.5
Sixty-Day.....	71.4	66.9	73.1	70.5
Markton X Rainbow (C.I. 3342).....	...	70.8	66.9	68.9
Gopher.....	71.0	63.5	65.5	66.7
Average.....	72.1	70.9	71.2	71.2

\*The 1941 crop was grown at Mt. Morris instead of DeKalb.

groats and the test weight were secured for certain oat varieties grown in 1939, 1940, and 1941 (Table 5).

In 1939 the percentage of groats averaged slightly higher than in 1940, tho this relation was not consistent among all varieties. On the other hand, weight per bushel was uniformly lower in 1939 than in 1940. In 1941 the varieties that weighed extremely low were also low in percentage of groats, but test weight did not always fluctuate with groats percentage.



TABLE 7.—POUNDS OF GROATS PRODUCED PER ACRE BY SIX VARIETIES OF OATS WHEN GROWN IN NORTHERN, CENTRAL, AND SOUTHERN ILLINOIS DURING 1939-1941

Variety	Northern Illinois (DeKalb)	Central Illinois (Urbana)	Southern Illinois (Alhambra)	Average
	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Marion (C.I. 3247).....	1 850.7	1 688.0	1 127.0	1 555.2
Illinois 30-2088.....	1 666.7	1 533.3	1 172.5	1 457.5
Gopher.....	1 682.5	1 435.6	1 072.3	1 396.8
Columbia.....	1 639.5	1 433.6	1 111.8	1 395.0
Fort.....	1 679.3	1 409.3	1 059.3	1 382.6
Sixty-Day.....	1 606.9	1 435.2	1 013.4	1 351.8
Average.....	1 687.6	1 489.2	1 092.7	1 423.2

For the seven varieties that were grown on all three crop fields, the average percentage of groats was lower in 1939 and in 1941 than in 1940 (Table 6). While in 1939 the DeKalb percentage did not differ greatly from that at Urbana, it was markedly higher than at Alhambra.

Since the hull-free kernels, or groats, are the most valuable parts of oat grains from the standpoint of livestock feeding, the yield in pounds of groats on three fields is shown in Table 7 for six of the varieties included in Table 6.

Each variety yielded the highest percentage of groats at DeKalb, next highest at Urbana, and lowest at Alhambra as an average of the three years 1939, 1940, and 1941. Marion exceeded the other five varieties on all three fields for all three years except in 1941 in southern Illinois, when it was exceeded by Illinois 30-2088.

### IMPROVEMENT THRU BREEDING

A good variety of oats should have a stiff straw; should be able to endure or be early enough to escape heat and drouth; be resistant to crown (leaf) rust, stem rust, and smut; have a low percentage of hull; and give good yields. Certain of the superior varieties have several of these characteristics (Table 8), but no single variety possesses all of them, or at least not to the highest degree. It is the purpose of the oat-improvement program to produce the ideal variety, one which has all the desirable characters expressed to the highest degree.

The importance of the characteristics listed as essential in a good oat variety is easily recognized. A stiff straw (Fig. 4) is becoming increasingly important with the use of more legumes in the rotation because legumes increase the available nitrogen and induce lodging. When oat plants lodge before the grain is ripe, constriction of the stems interferes with normal filling of the grain and thus lowers both yield and quality. Considerable loss of grain will also occur because

TABLE 8.—CHARACTERISTICS OF 71 VARIETIES OF SPRING OATS TESTED IN ILLINOIS

Variety	Section where grain yield was highest <sup>a</sup>	Yield above (+) or below (—) average <sup>b</sup>		Lodging resistance	Color of grain	Time of maturity	Resistance to—		Kind of panicle
		Grain	Straw				Stem rust	Crown rust	
		bu.	lbs						
Albion (Iowa 103).....	Northern	+4.5	— 29	Medium	White	Early	Poor	Poor	Spreading
Anthony.....	Central	+1.0	+ 36	Good	White	Midseason	Good	Poor	Spreading
Big Four.....	Central	+1.9	+ 33	Medium	White	Midseason	Poor	Poor	Spreading
Boone (C.I. 3305).....	Northern	+8.8	+ 03	Medium	Yellow	Early	Good	Good	Spreading
Brunker.....	Southern	+6.6	+ 06	Poor	Red	Early	Poor	Poor	Spreading
Burt.....	Central	+1.9	+ 13	Medium	Red	Early	Poor	Poor	Spreading
Burt (C.I. 293).....	Central	+3.9	— 10	Medium	Red	Early	Poor	Poor	Spreading
Burt (Nebr. 517).....	Central	+3.8	— 02	Medium	Red	Early	Poor	Poor	Spreading
Cartier.....	Central	+4.3	+ 10	Good	White	Midseason	Poor	Poor	Spreading
Columbia.....	Central	+5.2	+ 12	Good	Gray	Early	Poor	Poor	Spreading
Cornellian.....	Central	+1.8	+ 13	Good	Gray	Midseason	Poor	Poor	Spreading
Eagle.....	Central	+16.0	+ 13	Good	White	Late	Poor	Poor	Spreading
Erban.....	Central	— 2.2	+ 13	Good	White	Late	Poor	Poor	Spreading
Fort.....	Northern	+3.1	+ 20	Good	Yellow	Early	Poor	Poor	Spreading
Fowld Hull-less.....	Northern	— 1.1	+ 18	Medium	Flesh	Midseason	Poor	Poor	Spreading
Franklin.....	Central	+2.5	+ 18	Medium	Red	Midseason	Poor	Poor	Spreading
Golden Silvermine.....	Northern	+3.7	+ 20	Medium	White	Early	Poor	Poor	Spreading
Gophie.....	Central	+3.9	+ 10	Good	White	Early	Poor	Poor	Spreading
Grat Avalanche.....	Central	— 1.2	+ 16	Medium	White	Late	Poor	Poor	Side
Hancock (C.I. 3346).....	Northern	— 1.5	+ 10	Excellent	Yellow	Early	Good	Medium	Good
Illinois 105.....	Central	— 21.2	— 07	Medium	Flesh	Midseason	Poor	Poor	Spreading
Illinois 137.....	Central	— 5.0	— 07	Medium	Yellow	Early	Poor	Poor	Spreading
Illinois 147.....	Southern	— 2.2	— 05	Medium	Yellow	Early	Poor	Poor	Spreading
Illinois 30-2088.....	Central	+2.7	— 06	Good	Gray	Early	Poor	Poor	Spreading
Iogold.....	Central	+1.2	+ 41	Medium	Yellow	Early	Good	Poor	Spreading
Iogre.....	Central	+1.4	+ 02	Good	Yellow	Midseason	Medium	Poor	Spreading
Iowa D4.....	Northern	+15.8	— 38	Medium	White	Early	Good	Poor	Spreading
Iowa D67.....	Central	+16.9	— 39	Medium	White	Early	Good	Poor	Spreading
Iowa D69.....	Northern	+3.2	— 65	Medium	White	Early	Good	Poor	Spreading
Iowa D77.....	Northern	+12.9	+ 36	Medium	White	Early	Good	Poor	Spreading
Iowa D102.....	Central	+18.0	+ 47	Medium	White	Early	Good	Poor	Spreading
Iowa.....	Northern	+6.1	— 06	Medium	White	Early	Poor	Poor	Spreading
Kanota.....	Central	+4.7	+ 34	Good	Red	Early	Poor	Poor	Spreading
Keystone.....	Central	— 5.6	+ 20	Medium	Yellow	Midseason	Poor	Poor	Spreading
Legacy.....	Northern	— 12.1	+ 10	Good	White	Late	Poor	Poor	Spreading
Marion (C.I. 3247).....	Northern	+10.5	+ 07	Good	White	Early	Poor	Medium	Spreading
Markton.....	Central	+3.8	+ 19	Medium	Yellow	Midseason	Good	Poor	Spreading

TABLE 8.—CHARACTERISTICS OF 71 VARIETIES OF SPRING OATS—*Concluded*

Variety	Section where grain yield was highest <sup>a</sup>	Yield above (+) or below (—) average <sup>b</sup>			Lodging resistance	Color of grain	Time of maturity	Resistance to—		Kind of panicle
		Grain	Straw	Stalk				Stem rust	Crown rust	
		<i>bu.</i>								
		<i>lbs.</i>								
Markton X logold (C.I. 3237)	Northern	+7	—34	—32	Good	Yellow	Early	Good	Medium	Spreading
Markton X logold (C.I. 3239)	Southern	+1.6	—34	—34	Good	Yellow	Early	Good	Medium	Spreading
Markton X logold (C.I. 3240)	Central	+1.1	—03	—03	Good	Yellow	Early	Good	Medium	Spreading
Markton X logold 2737 (Sel. 200-5)	Central	+4.0	—02	—02	Good	Yellow	Early	Good	Medium	Spreading
Markton X Rainbow (C.I. 3241)	Central	+2.4	+14	+14	Good	White	Early	Good	Medium	Spreading
Markton X Rainbow (C.I. 3341)	Central	+3.5	+05	+05	Good	White	Early	Good	Medium	Spreading
Markton X Rainbow (C.I. 3342)	Central	+2.7	+07	+07	Good	White	Early	Good	Medium	Spreading
Mark-Rain. X Vict.-Rich. (C.I. 3607)	Central	+9.6	—06	—06	Good	Yellow	Early	Good	Good	Spreading
Miami	Central	—1.0	+13	+13	Good	White	Midseason	Poor	Poor	Spreading
Minota	Central	+3.4	+63	+63	Good	White	Midseason	Poor	Poor	Spreading
Naesgaard	Central	—7.5	+23	+23	Good	White	Late	Poor	Poor	Spreading
Nebraska 21	Central	+2.9	—21	—21	Medium	White	Early	Poor	Poor	Spreading
Nova	Central	—6	+57	+57	Good	White	Midseason	Poor	Poor	Spreading
Patterson	Central	—5.5	+14	+14	Medium	Yellow	Early	Good	Poor	Spreading
Royal Scott	Northern	+3.6	—33	—33	Excellent	White	Midseason	Poor	Poor	Spreading
Rustless (Iowa 105)	Central	+8.4	+07	+07	Good	White	Early	Poor	Poor	Spreading
Rustless (Iowa 444)	Central	+1.2	+16	+16	Good	White	Late	Poor	Poor	Side
Silver	Central	—6.7	+12	+12	Good	White	Midseason	Poor	Poor	Spreading
Silvermine	Northern	+1.4	—18	—18	Medium	White	Late	Poor	Poor	Spreading
Sixty-Day	Central	+2.8	—20	—20	Medium	Yellow	Early	Poor	Poor	Spreading
Sixty-Day (Selection)	Central	—8.1	—28	—28	Medium	Yellow	Early	Poor	Poor	Spreading
State Pride (Wis. 7)	Central	+2.7	—64	—64	Medium	Yellow	Early	Poor	Poor	Spreading
Swedish Star	Northern	+1.5	+32	+32	Good	White	Late	Poor	Poor	Spreading
Tama (C.I. 3502)	Central	+16.2	+03	+03	Good	White	Early	Good	Good	Spreading
Texas Red	Central	0	—04	—04	Medium	Red	Midseason	Poor	Poor	Spreading
Vanguard	Northern	+4.1	+26	+26	Good	White	Midseason	Good	Poor	Spreading
Vicland (C.I. 3611)	Central	+10.0	—11	—11	Good	White	Early	Good	Good	Spreading
Victor	Northern	—6.6	+79	+79	Good	White	Late	Poor	Poor	Spreading
Victoria X Richland (C.I. 3310)	Central	+15.6	—13	—13	Good	Yellow	Early	Good	Good	Spreading
Victoria X Richland (C.I. 3336)	Central	+8.1	—08	—08	Good	Yellow	Early	Good	Good	Spreading
Victoria X Richland (C.I. 3337)	Northern	+14.6	—03	—03	Good	Yellow	Early	Good	Good	Spreading
Victoria X Richland (C.I. 3602)	Northern	+17.3	—17	—17	Good	Yellow	Early	Good	Good	Spreading
Victory	Central	—2.4	+26	+26	Good	White	Midseason	Poor	Poor	Spreading
Wayne	Northern	+2.1	+19	+19	Good	White	Midseason	Poor	Poor	Spreading

<sup>a</sup>A number of the varieties have not been grown in all three sections of the state.<sup>b</sup>Average of all varieties grown the same years in the test plots.



Fig. 4.—A stiff-strawed early-maturing variety. Not only is a variety such as this easy to harvest and high yielding, but it is also an excellent nurse crop for clovers.

harvesting lodged oats is not only difficult but next to impossible. Finally, the lodged straw will tend to smother out the clover companion crop when it is in the process of establishing itself (Fig. 5).

Early varieties in general are most desirable for Illinois. Over a period of time they will yield more than later varieties because they usually mature in time to escape hot and dry weather while the grain is filling (Fig. 6). However, in exceptional seasons when hot weather does not come until later, varieties of the midseason type and in a few cases even varieties of the late type have a chance to mature normally. When this happens the late oats yield more than the early varieties.

Resistance to drouth, heat, and disease help to maintain consistent yields from year to year. A low percentage of hull means less waste whether the oats are used as livestock feed or in the manufacture of human food. High grain yield per acre is probably most important of all because it means a lower cost per unit of grain produced. It is the result partly of the other characters mentioned—stiff straw, resistance to drouth, heat, and disease, and low percentage of hull—and so for that reason too it is the final basis upon which the value of new varieties is determined.





Fig. 5.—A variety that lodges, as this plot of Bruncker oats did in 1937, yields low and is difficult to harvest. It also tends to smother the clover when it is used as a nurse crop.

An oat-improvement program starts with the selection of individual plants or single heads of plants from a population that appears to have as many of the desired characters as possible. The grains from each head or plant are kept separate and planted in separate rows or plots thruout the testing period. Each year the separate progenies are examined to see if they still possess the desired characters and to note



Fig. 6.—The early variety (*left*) and the midseason variety (*right*) were grown side by side in drilled plots on the DeKalb field. When this picture was taken (*June 20, 1936*) the early variety had already headed, altho the plants were not much taller than those of the midseason variety. Matured plants of midseason varieties are ordinarily taller than those of early varieties, but in most seasons in Illinois the early varieties produce more grain.

any unusual adverse behavior that has not been noticed before. On the basis of studies made each year many selections are discarded and those that have the best characteristics are kept for testing on the crop experiment fields in various parts of the state. Finally the new varieties that have proved successful in the tests are named and increased for distribution.

There are two kinds of plant populations from which new oat varieties may be selected: old varieties and hybrids. Old varieties are found many times to be mixtures of types which have arisen in a number of ways, such as by natural crossing, mechanical mixing, or by a sudden change in the hereditary determiners of certain plants. It is these variations or mixtures that are selected. Hybrids are excellent sources for the selection of new varieties because their progenies usually express all possible combinations of the characters of both parents.

Whether old varieties or hybrids are used, there are limitations to the possibilities of selection. If, for example, the variety has a weak straw, selection is limited to finding types with straw stronger than the average of the variety; but even the selections with the strongest straw may never have straw as strong as that of some other variety which has this as one of its outstanding characteristics. In the case of hybrids selection is limited to the combination of those desirable characters possessed by the parent types. Seldom do selections from a hybrid show any higher expression of a character than that of the parent which contributed it. The improvement that can be attained thru hybridization is therefore limited usually to bringing into combination characters that existed in separate varieties.

Selection from old varieties has until recently been the chief method of obtaining improved varieties of oats. From Kherson and Sixty-Day, probably identical types, have come many good varieties. A partial list of these varieties, together with the names of the experiment stations selecting them, follows:

<i>New variety</i>	<i>Parent variety</i>	<i>Station making selection</i>
Richland.....	Kherson.....	Iowa
Iogold.....	Kherson.....	Iowa
Albion.....	Kherson.....	Iowa
Iowar.....	Kherson.....	Iowa
Fort.....	Sixty-Day.....	Illinois
Gopher.....	Sixty-Day.....	Minnesota
Nebraska 21.....	Kherson.....	Nebraska
Higmore.....	Kherson.....	South Dakota
State Pride.....	Kherson.....	Wisconsin

Similar lists could be made of improved varieties that have been selected from Fulghum, Red Rustproof, Silvermine, and other widely grown varieties. All the varieties originating by selection from old varieties have started from seed taken from a single head or a single

plant. In each case the varieties selected from Kherson or Sixty-Day were superior to the parent variety in one or more of the following characters: stiffness of straw, resistance to stem rust, thinness of hull, earliness, and yield.

In recent years the new distributed varieties, such as Marion, Boone, Vicland, and Hancock, have been selected from hybrids. Marion, distributed for the first time in Illinois in 1940, was selected by T. R. Stanton and his associates of the U. S. Department of Agriculture from a cross of Markton  $\times$  Rainbow. Markton is highly resistant to loose and covered smut but is susceptible to crown or leaf rust and stem rust. Rainbow is susceptible to loose and covered smut but resistant to stem rust and moderately resistant to crown or leaf rust. Marion has the disease resistance of both parents and in addition gives a good yield of high-quality grain.

Boone and Vicland, developed by the group of workers who produced Marion, were selected from a cross of Victoria  $\times$  Richland. Victoria is resistant to loose and covered smut and crown or leaf rust but susceptible to stem rust. Richland, on the other hand, is susceptible to loose and covered smut and to crown or leaf rust but it is resistant to stem rust. In addition to having the disease resistance of both parents, Boone and Vicland give a high yield of good-quality grain.

Other examples of selections from hybrids could be cited to show how crossing has been used to produce new varieties.

No particular importance should be attached to the fact that an oat variety is of hybrid origin; that is, that it has been selected from the progeny of a cross between two varieties. If an oat variety selected from a hybrid is pure, its characters will breed just as true as those of a pure-line selection from a variety. Its value depends upon the characters it possesses and not upon its hybrid origin.

Finding the individual plants for selection from the progeny of a cross is a difficult task. The plant selected should have as many good characters as the parents and as few bad characters as possible. To distinguish resistant plants from the susceptible ones, all plants must be grown in the presence of those diseases and environmental conditions to which resistance is wanted. Furthermore a large number of plants of a cross must be grown because the larger the number of characters wanted, the fewer will be the plants that will possess all of them.

To test the resistance of different varieties, methods have been devised to produce epidemics of disease or special growing conditions simulating drouth, heat, or other environmental conditions. For example, epidemics of crown or leaf rust and stem rust can be produced nearly every year by planting a rust-susceptible variety of oats thruout the breeding nursery and then inoculating the plants with rust when they are in the late vegetative stage. The inoculated plants become

infected with rust and spread the disease to plants of susceptible varieties. Thus by using special methods of producing epidemics or particular growing conditions, selection for resistance can be made every year, whereas under natural conditions several years might elapse before a variety would be tested for its resistance to a disease or to extreme growing conditions.

## CHOOSING A VARIETY TO GROW

In choosing a variety of oats to grow, the most important consideration is usually the yield of grain. A high yield over a period of years indicates that the variety is well adapted.

Characteristics that are associated with high-yielding ability under Illinois conditions, as mentioned previously, include earliness, resistance to rusts and other diseases, and ability to stand erect and hold grain until harvest.

Sometimes the yield of straw is as important in an oat variety as the yield of grain. If such is the case, the sacrifice of a few bushels in the yield of grain may be advisable in order to get a variety with a high straw yield.

The best recommendation a variety can possess is a high record of performance in comparative tests. Such records are given in Tables 1, 2, and 3 and a concise description of all varieties included can be found in Table 8.

## RATE AND METHOD OF SEEDING

The oat plant has a large capacity to tiller when seeded at less than the optimum rate. Over a five-year period Gopher oats produced the highest yield, 67.2 bushels when seeded with a drill in 8-inch rows at 8 pecks an acre (Table 9). When seeded at one-fourth this rate, the yield was 8 bushels an acre less, or 59.2 bushels. These results indicate clearly that the rate of seeding oats can be greatly reduced when seed is scarce and a rapid increase is desired.

Unfortunately no broadcast rate as heavy as 12 pecks an acre was made, but up to 10 pecks the yield increased with each increment of 2 pecks of seed. However, the broadcast method wastes seed and should not be practiced with expensive seed of a new variety.

In order to favor the clover companion crop, oats are sometimes seeded in wide drill rows. As a means of ascertaining the influence of this method of seeding oats upon the yield of the clover crop, the drill used for seeding was closed at every other opening, making the distance between rows 16 inches. With this wide row the maximum yield was obtained at the 8-peck rate, but even at this rate the yield was 8.5 bushels an acre less than that obtained from the 8-inch drill row seeded at 8 pecks an acre.



TABLE 9.—AVERAGE YIELD OF GRAIN AND STRAW FROM GOPHER OATS SEEDING AT DIFFERENT RATES AND IN DIFFERENT WAYS, URBANA, 1933-1937

Pecks of seed used per acre	Acre-yield when sowed broadcast	Acre-yield when sowed with a drill in—	
		8-inch rows	16-inch rows
Grain			
	<i>bu.</i>	<i>bu.</i>	<i>bu.</i>
2.....	47.8	59.2	50.7
4.....	55.3	61.8	56.0
6.....	60.0	62.9	55.2
8.....	63.9	67.2	58.7
10.....	66.4	65.1	56.8
12.....	....	63.2	57.0
Average.....	58.7	63.2	55.7
Straw			
	<i>tons</i>	<i>tons</i>	<i>tons</i>
2.....	.866	1.265	1.117
4.....	1.145	1.262	1.167
6.....	1.144	1.238	1.148
8.....	1.330	1.321	1.221
10.....	1.395	1.310	1.240
12.....	....	1.362	1.279
Average.....	1.176	1.293	1.195

The yield of straw tended to increase as the rate of seeding increased, regardless of the method of seeding. Below 8 pecks an acre, broadcast seeding gave a lower straw yield than did drilling, but at the 8- and 10-peck rates the broadcast seeding yielded more straw than drilling. Drilling in 8-inch rows gave a higher yield of straw than drilling in 16-inch rows at all comparable rates of seeding tested.

Tho not markedly influenced by rate of seeding, the amount of lodging tended to vary inversely with the amount of seed sowed. At the same rate of seeding, oats that were broadcast lodged less than drilled oats. This is believed to be due to the fact that fewer oat grains produced plants in the broadcast plots than in the drill plots. Therefore the population on the broadcast plot was comparable to that on a drill plot seeded at a lower rate.

The oats in 16-inch rows lodged considerably more than those in 8-inch rows seeded at the same rate per acre. Apparently plants crowded together in rows that are widely spaced are in an environment similar to that of plants growing in more closely spaced rows seeded at a higher rate.

Different rates and methods of seeding the oat crop were tested to show their effect upon the number and height of plants in the clover companion crop (Table 10).

TABLE 10.—NUMBER AND HEIGHT OF CLOVER PLANTS AS AFFECTED BY RATE AND METHOD OF SEEDING GOPHER OATS, URBANA, 1933-1937  
(Plants were counted and measured after oats were harvested)

Pecks of seed used per acre	Broadcast sowing	Drilled sowing in—	
		8-inch rows	16-inch rows
Plants per 27 square feet			
2.....	255	195	158
4.....	179	154	160
6.....	172	116	153
8.....	147	101	145
10.....	163	109	135
12.....	...	91	128
Average.....	163	128	147
Average height of plants			
	<i>in.</i>	<i>in.</i>	<i>in.</i>
2.....	4.65	4.87	5.67
4.....	4.24	4.14	4.79
6.....	4.32	3.55	4.17
8.....	4.30	3.39	3.64
10.....	4.07	2.87	3.94
12.....	....	2.87	3.80
Average.....	4.32	3.62	4.34

As might be expected, the number of clover plants was greater in the broadcast than in the drilled plots. The smaller yield of oats from the broadcast plots would tend to favor the clover. The fewest clover plants occurred, on the average, on plots seeded in 8-inch drill rows, but these plots produced the highest yields of oats. The development of clover plants was greater in the 16- than in the 8-inch rows, as shown by the larger number of plants per triple-yard as well as by their greater average height (Fig. 7). In general the thicker the oats were seeded the less favorable were growing conditions for the clover plants.

### RECOMMENDED GROWING PRACTICES

Spring oats usually follow corn in the rotation. Plowing usually results in larger yields; but if the date of seeding has to be delayed in order to plow the land, the extra cost of plowing may not be covered by the increased yield of oats. Seeding with a drill saves seed and usually gives larger yields than broadcasting; but here again if drilling slows up the seeding so that the last half of the crop goes in late, drilling may not be justified.

Seed treatment is advised for smut-susceptible varieties, especially if the seed carries smut spores. If New Improved Ceresan dust is used



Fig. 7.—Thick seeding and close drilling (*left*) hasten ripening and reduce the height of the oat crop. These shorter plants were seeded at a 15-peck rate in 8-inch drill rows; the taller plants (*right*) were seeded at a 2½-peck rate in 16-inch drill rows. Growth of clover is favored by seeding oats at a low rate and in wide drill rows.

and some days are to elapse before it will be sowed, not more than ¼ ounce per bushel should be used.<sup>1</sup> For smut-resistant varieties and for susceptible varieties that do not carry smut spores, seed treatment is of doubtful benefit.<sup>2</sup> But as a form of insurance against smut, seed treatment is cheap and effective.

Moderately early seeding is recommended; extremely early seeding sometimes results in weak and uneven stands.

Soil-treatment materials are seldom applied directly for oats, since most soil-management plans call for the application of such materials ahead of corn and wheat.

The following conditions and practices help to assure success with spring oats:

1. Choice of an adapted high-yielding variety.
2. Sowing the seed moderately early, preferably with a drill.
3. Adjusting rate of seeding to method of seeding. If seeding is done with a drill, 8 pecks should be used per acre. If broadcast, 10

<sup>1</sup>Koehler, Benjamin. Effect of storage on yields of farm seed treated for disease control. Ill. Agr. Exp. Sta. Bul. 476. 1941.

<sup>2</sup>Leukel, R. W., and Stanton, T. R. Effect of seed treatments on yield of oats. Jour. Amer. Soc. Agron. 26, 851-857. 1934.

pecks an acre will give the best results. When a legume is seeded in the oats, the best rate is 4 pecks of oats an acre if the oats are drilled and 6 pecks if broadcast.

4. Harvesting the ripened crop with a binder and threshing it with a regular small-grain separator; or harvesting with a windrower and following this with a pick-up combine when the grain is dry enough to bin.

## SUMMARY

Acre-yields of oats in Illinois have increased during the past forty-five years as a result of extensive use of better adapted, early-maturing varieties. During all of this time tests have been conducted by the Illinois Agricultural Experiment Station on representative plots in different parts of the state to determine which varieties were best adapted to those sections as shown by their grain yield. This bulletin reports the results of tests conducted during the last twelve years and includes 71 varieties which have been grown for periods varying from one year to the entire twelve. The development of a variety that has all desirable characters expressed to the highest degree is the ultimate aim of the oat-improvement program of which these tests are a part.

On the northern Illinois field the five varieties yielding the most grain among those grown for three years or longer were Marion, Iowar, Albion, Richland, and Gopher.

On the Urbana field in central Illinois the best producing varieties in tests for three or more years were Marion, Columbia, Boone, Kanota, and Gopher.

In southern Illinois on the Alhambra field the leading varieties in yield of grain during three or more years of tests were Brunker, Columbia, Burt (C.I. 293), Markton  $\times$  Rainbow (C.I. 3341), and Marion. Columbia can be considered the best all-round variety for southern Illinois until some new varieties demonstrate their superiority to it.

Altho Marion has produced the highest yield of grain on both the northern and central experiment fields during the four years it has been included in the tests, some of the new selections out of Victoria  $\times$  Richland have produced more bushels above the average yield for the one or two years that they were tested.

In the main, varieties that yielded the most grain in northern and central Illinois produced less than average yields of straw. The reverse was true in southern Illinois but there the average yield of straw is low.

Percentage of groats is apparently a better measure of quality in oats than weight per bushel. Marion had the highest average yield of groats per acre of any variety in the tests for the last three years.

Oats seeded with a drill at the rate of 8 pecks an acre gave the

highest yields. Broadcast seeding at 10 pecks gave as good yields as drilled seeding at this rate.

Seeding oats in 16-inch drill rows resulted in lower yields than drilling them in 8-inch rows, but the wide space between drill rows favored the growth of clover.

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Improved varieties have increased yields markedly during the last few years and even better varieties are in prospect. Marion and selections out of a cross of Victoria and Richland show particular promise because they possess a combination of desirable characteristics: a white or yellow kernel, a relatively thin hull, a high test weight, resistance to stem rust, crown rust, and smut, and capacity for high yields.













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